

The first full paragraph on page 23 is amended.

The paragraph bridging pages 23-24 is amended.

In the claims:

Without prejudice, and reserving the right to file divisional applications with respect thereto, please cancel claims 1-7 and 14.

Claims 8, 9, 10 and 12 are amended.

REMARKS

The Office Action dated February 6, 2003 has been received and carefully studied.

Applicant affirms the election to prosecute the invention of Group II, claims 8-13. By the accompanying amendment, claims 1-7 and 14 have been cancelled without prejudice.

The Examiner objects to the drawings for various reasons. Submitted herewith are corrected Figures 5 and 10 for approval. In addition, the specification has been amended to clarify various reference characters noted by the Examiner.

The Examiner objects to the disclosure due to certain informalities which have been corrected by the accompanying amendment.

The Examiner rejects claims 8-13 under 35 U.S.C. §112, second paragraph, as being indefinite for various reasons.

By the accompanying amendment, claim 8 has been amended to recite the relationship between the radial duct and the outer housing. Claim 9 has been amended to recite the relationship between the second valve port and the second heat exchange bed.

Claim 10 has been amended to recite that the chambers are congruent with respect to one another. Applicant submits that the term "congruent" is being used in its common and usual geometric sense, e.g., to mean that each chamber has the same shape. Claim 12 has been amended to provide proper antecedent basis. It is believed that the amendments overcome the rejection.

The Examiner rejects claims 8 and 11-13 under 35 U.S.C. §102(b) as being anticipated by Houston, U.S. Patent No. 5,692,892. The Examiner states that Houston discloses a regenerative thermal oxidizer comprising a combustion zone 19, a first heat exchange bed 13 containing heat exchange media and in communication with the combustion zone 19, a second heat exchange bed 14 containing heat exchange media and in communication with the combustion zone 19, means 21 for causing gas to flow into the duct, a valve 12 for alternating the flow of gas between the first and second heat exchange bed, the valve comprising a radial duct, an outer housing 26, a ring seal 39 having a bore adapted to allow gas flow to or from the duct and form a seal with the housing, valve ports 31, 32 connected to the first and second heat exchange beds, respectively, inlet and outlet manifolds 51, 52, and drive means 41 for rotating the valve.

By the accompanying amendment, claim 8 has been amended to recite that the radial duct is enclosed by the outer housing. As a result, the ring seal seals the valve against the outer housing when pressurized gas flows from (or to) the radial duct.

In contrast, as seen in Figure 10, the seal assembly of

Houston uses a combination of a seal structure 39 and wiper blades 43, 44 to seal. A pressurized seal is not created between a radial duct and an outer housing enclosing that duct as recited in claim 8; instead a pressurized seal is created between a duct and the seal structure 39 itself. Thus Figure 10 shows a chamber 47 defined by wiper blades 43, 44 and seal structure 39. The corresponding "chamber" in the instant invention is defined between seal ring 664 and the housing 659, distribution groove 145 and the housing 659, arc 663 and the housing 659, and mounting ring 091 and the housing 659, as illustrated in Figure 11 and as discussed in the paragraph bridging pages 23-24 of the instant specification. This is nowhere disclosed or suggested by Houston.

Claims 11-13 are believed to be allowable by virtue of their dependence.

The Examiner rejects claims 8-13 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-10 of U.S. Patent No. 6,261,092. The Examiner states that these claims are not patentably distinct from each other because they are directed to the same conceptual invention.

The rejection is respectfully traversed.

As an initial matter, the legal basis for an obviousness-type double patenting rejection is not whether the claims of the application are directed to the same conceptual invention as the claims of the cited patent. Rather, as set forth in MPEP §804(II)(B), the issue is whether any claim in the application defines an invention that is merely an obvious variation of an

invention claimed in the patent. Factors relevant in this inquiry include: (A) a determination of the scope and content of the patent claim and the prior art relative to a claim in the application; (B) a determination of the differences between the scope and content of the patent claim and the prior art as determined in (A) and the claim in the application; (C) a determination of the level of ordinary skill in the art; and (D) an evaluation of any objective indicia of nonobviousness.

MPEP §804 further states that any obviousness-type double patenting rejection should make clear: (A) the differences between the inventions defined by the conflicting claims -- a claim in the patent compared to a claim in the application; and (B) the reasons why a person of ordinary skill in the art would conclude that the invention defined in the claim in issue is an obvious variation of the invention defined in a claim in the patent.

The Office Action is completely silent as to any of these factors.


Applicant respectfully submits that claims 8-13 define an invention that is not an obvious variation of any invention claimed in the '092 patent. Specifically, instant claim 8 is specific to the sealing assembly of the rotatable switch valve, and requires that a ring seal in fluid communication with a radial duct have a bore that allows gas flow to or from the radial duct to form a pressurized seal with the outer housing enclosing the duct. In contrast, claims 1-4 of the '092 patent are completely silent as to any sealing system; claims 7 and 8 of the '092 patent relate to the

cushion of gas that is created between a mating surface and a sealing plate and not to the rotating port sealing system; and claims 9 and 10 of the '092 patent relate to the drive system for rotating the valve. Accordingly, these claims are completely irrelevant in the context of an obviousness-type double patenting inquiry.

Claim 5 of the '092 patent is specific to the rotating port sealing system of the valve, but nowhere discloses or suggests a ring seal having a bore that allows gas flow to or from the radial duct to form a pressurized seal with the outer housing as required by claim 8. Instead, claim 5 requires an outer ring seal, an inner ring seal spaced from the outer ring seal and having a plurality of bores, and at least one piston ring positioned in a respective one of the plurality of bores in the inner ring seal and biasing against the outer ring seal. As recited in claim 6, gas flows between the piston ring and the outer ring seal. This is very different from the instant invention as claimed.

Reconsideration and allowance are respectfully requested in view of the foregoing.

Respectfully submitted,


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Version with Markings to Show Changes Made

In the specification:

Paragraph bridging pages 9-10:

Turning now to Figure 3, the details of the cold face plenum 20 will be discussed. The plenum 20 has a floor 23 which is preferably sloped downwardly from outside walls 20A, 20B towards the valve ports [25] 25A-25F to assist in gas flow distribution. Supported on floor 23 are a plurality of divider baffles 24, and chamber dividers [124] 124A, 124D, 124E and 124H. The divider baffles 24 separate the valve ports [25] 25A-25F, and help reduce pressure fluctuations during valve switching. The chamber dividers [124] separate the heat exchange chambers. Chamber dividers 124A and 124D, and 124E and 124H, may be respectively connected with each other or separate. Valve port 25A is defined between chamber divider 124A and baffle 24B; valve port 25B is defined between baffles 24B and 24C; valve port 25C is defined between baffle 24C and chamber divider 124D; valve port 25D is defined between chamber divider 124E and baffle 24F; valve port 25E is defined between baffles 24F and 24G; and valve port 25F is defined between baffle 24G and chamber divider 124H. The number of divider baffles [24] is a function of the number of valve ports. [25.] In the preferred embodiment as shown, there are six valve ports [25] 25A-25F, although more or less could be used. For example, in an embodiment where only four valve ports are used, only one divider baffle would be necessary. Regardless of the number of valve ports and corresponding divider baffles, preferably the valve ports are

equally shaped for symmetry.

Page 11, first full paragraph:

Preferably the baffles 24B, 24C, 24F and 24G, as well as the walls 20A, 20B, 20C and 20D of the cold face plenum 20, include a lip 26 extending slightly lower than the horizontal plane defined by the top surface of the baffles. [25.] The lip 26 accommodates and supports an optional cold face support grid 19 (Figure 2), which in turn supports the heat exchange media in each column. In the event the heat exchange media includes randomly packed media such as ceramic saddles, spheres or other shapes, the baffles [24] can extend higher to separate the media. However, perfect sealing between baffles is not necessary as it is in conventional rotary valve designs.

Paragraph bridging pages 11-12:

Figure 4 is a view of the valve ports [25] 25A, 25B, 25C from the bottom. Plate 28 has two opposite symmetrical openings 29A and 29B, which, with the baffles [26] 24, define the valve ports. [25.] Situated in each valve port [25] is an optional turn vane 27. Each turn vane 27 has a first end secured to the plate 28, and a second end spaced from the first end secured to the baffle 24 on each side (best seen in Figure 3). Each turn vane 27 widens from its first end toward its second end, and is angled upwardly at an angle and then flattens to horizontal at 27A as shown in Figures 3 and 4. The turn vanes 27 act to direct the flow of process gas emanating

from the valve ports away from the valve ports to assist in distribution across the cold face plenum during operation. Uniform distribution into the cold face plenum 20 helps ensure uniform distribution through the heat exchange media for optimum heat exchange efficiency.

Paragraph bridging pages 12-13:

Figures 5 and 5A show the flow distributor 50 contained in a manifold 51 having a process gas inlet 48 and a process gas outlet 49 (although element 48 could be the outlet and 49 the inlet, for purposes of illustration the former embodiment will be used herein). The flow distributor 50 includes a preferably hollow cylindrical drive shaft 52 (Figures 5A, 10) that is coupled to a drive mechanism discussed in greater detail below. Coupled to the drive shaft 52 is a partial frusto-conically shaped member or frusto-conical section 53. The member 53 includes a mating plate formed of two opposite pie-shaped sealing surfaces 55, 56, each connected by circular outer edge 54 and extending outwardly from the drive shaft 52 at an angle of 45°, such that the void defined by the two sealing surfaces 55, 56 and outer edge 54 defines a first gas route or passageway 60. Similarly, a second gas route or passageway 61 is defined by the sealing surfaces 55, 56 opposite the first passageway, and three angled side plates, namely, opposite angled side plates 57A, 57B, and central angled side plate 57C. The angled sides plates [57] 57A, 57B separate passageway 60 from passageway 61. The top of these passageways 60, 61 are

designed to match the configuration of symmetrical openings 29A, 29B in the plate 28, and in the assembled condition, each passageway 60, 61 is aligned with a respective openings 29A, 29B. Passageway 61 is in fluid communication with only inlet 48, and passageway 60 is in fluid communication with only outlet 49 via plenum 47, regardless of the orientation of the flow distributor 50 at any given time. Thus, process gas entering the manifold 51 through inlet 48 flows through only passageway 61, and process gas entering passageway 60 from the valve ports 25 flows only through outlet 49 via plenum 47.

Paragraph bridging pages 13-14:

Turning now to Figure 6, a suitable drive mechanism for driving the flow distributor 50 is shown. The drive mechanism 70 includes a base 71 and is supported on frame 12 (Figure 1). Coupled to base 71 are a pair of rack supports 73A, 73B and a cylinder support 74. Cylinders 75A, 75B are supported by cylinder support 74, and actuate a respective rack 76A, 76B. Each rack has a plurality of grooves which correspond in shape to the spurs 77A on spur gear 77. The drive shaft 52 of the flow distributor 50 is coupled to the spur gear 77. Actuation of the cylinders 75A, 75B causes movement of the respective rack [76] 76A, 76B attached thereto, which in turn causes rotational movement of spur gear 77, which rotates the drive shaft 52 and flow distributor 50 attached thereto about a vertical axis. Preferably the rack and pinion design is configured to cause a back-and-forth 180° rotation of the

drive shaft 52. However, those skilled in the art will appreciate that other designs are within the scope of the present invention, including a drive wherein full 360° rotation of the flow distributor is accomplished. Other suitable drive mechanisms include hydraulic actuators and indexers.

Paragraph bridging pages 18-19:

The preferred method for sealing the valve will now be discussed first with reference to Figures 5, 8 and 9. The flow distributor 50 rides on a cushion of air, in order to minimize or eliminate wear as the flow distributor moves. Those skilled in the art will appreciate that gases other than air could be used, although air is preferred and will be referred to herein for purposes of illustration. A cushion of air not only seals the valve, but also results in frictionless or substantially frictionless flow distributor movement. A pressurized delivery system, such as a fan or the like, which can be the same or different from the fan used to supply the combustion air to the combustion zone burner, supplies air to the drive shaft 52 of the flow distributor 50 via suitable ducting (not shown) and plenum 64. Alternatively, negative pressure could be used. As best seen in Figure 8 (illustrating a positive pressure system), the air travels from the ducting into the drive shaft 52 via one or more apertures 81 formed in the body of the drive shaft 52 above the base 82 of the drive shaft 52 that is coupled to the drive mechanism 70. The exact location of the apertures(s) 81 is not particularly limited,

although preferably the apertures [18] 81 are symmetrically located about the shaft 52 and are equally sized for uniformity. The pressurized air flows up the shaft as depicted by the arrows in Figure 8, and a portion enters [on] one or more radial ducts 83 which communicate with and feed a ring seal located at the annular rotating port 90 as discussed in greater detail below. A portion of the air that does not enter the radial ducts 83 continues up the drive shaft 52 until it reaches passageways 94, which distribute the air in a channel having a semi-annular portion 95 and a portion defined by the pie-shaped wedges or sealing surfaces 55, 56. The flow in a negative pressure system would be the reverse.

Paragraph beginning on page 19 and ending on page 21:

The mating surface of the flow distributor 50, in particular, the mating surfaces of pie-shaped wedges 55, 56 and outer annular edge 54, are formed with a plurality of apertures 96 as shown in Figure 5. The pressurized air from channel 95 escapes from channel 95 through these apertures 96 as shown by the arrows in Figure 8, and creates a cushion of air between the top surface of the flow distributor 50 and a stationary seal plate 100 shown in Figure 9. The seal plate 100 includes an annular outer edge 102 having a width corresponding to the width of the top surface or outer annular edge 54 of the flow distributor 50, and a pair of pie-shaped elements 105, 106 corresponding in shape to pie-shaped wedges 55, 56 of the flow distributor 50. It matches (and is coupled to) plate 28 (Figure 4) of the valve port. Aperture 104

receives shaft pin 59 (Figure 8) coupled to the flow distributor 50. The underside of the annular outer edge 102 facing the flow distributor includes one or more annular grooves 99 (Figure 9A) which align with the apertures 96 in the mating surface of the flow distributor 50. Preferably there are two concentric rows of grooves 99, and two corresponding rows of apertures 96. Thus, the grooves 99 aid in causing the air escaping from apertures 96 in the top surface or outer annular edge 54 to form a cushion of air between the mating surface 54 and the annular outer edge 102 of the seal plate 100. In addition, the air escaping the apertures 96 in the pie-shaped portions or sealing surfaces 55, 56 forms a cushion of air between the pie-shaped portions 55, 56 and the pie-shaped portions or elements 105, 106 of the seal plate 100. These cushions of air minimize or prevent leakage of the process gas that has not been cleaned into the flow of clean process gas. The relatively large pie-shaped wedges of both the flow distributor 50 and the seal plate 100 provide a long path across the top of the flow distributor 50 that uncleaned gas would have to traverse in order to cause leakage. Since the flow distributor is stationary the majority of time during operation, an impenetrable cushion of air is created between all of the valve mating surfaces. When the flow distributor is required to move, the cushion of air used to seal the valve now also functions to eliminate any high contact pressures from creating wear between the flow distributor 50 and the seal plate 100.

Page 21, second full paragraph:

The flow distributor 50 includes a rotating port 90 as best seen in Figures 10 and 11. The frusto-conical section 53 of the flow distributor 50 rotates about an annular wall or ring seal housing 659 that functions as an outer ring seal. The housing 659 includes an outer annular flange 111 used to center the [housing] housing 659 and clamp it to the manifold 51 (see also Figure 5A).

Paragraph bridging pages 21-22:

Turning now to Figure 11, details are shown of one embodiment of the improved sealing system in accordance with the present invention. Retaining ring seal 664, preferably made of carbon steel, is shown attached to rotating assembly or frusto-conical section 53. The retaining seal ring 664 is preferably a split ring as shown in perspective view in Figure 11A, and has a cross-section as shown in Figure 11B. Splitting the ring facilitates installation and removal. Figure 13 shows retaining seal ring 664 attached to the rotating assembly or frusto-conical section 53 with a cap screw 140. Other suitable means for attaching the ring 664 could be used. Preferably, the rotating assembly includes a groove 700 (Figure 13) for properly positioning the retaining ring seal in place.

Paragraph bridging pages 22-23:

In the embodiment shown, where the rotating assembly rotates about a vertical axis, the weight of the seal ring 658 can result in wear as it slides against the mounting ring 091. In order to

reduce or eliminate this wear, the mounting ring [663] 091 is formed with a tongue 401 formed along its circumference, preferably centrally located as best shown in Figure 11D. A optional plate-bearing arc 663 has a groove 402 (Figures 11E, 11F) corresponding in shape and location to the tongue 401, and seats over the mounting ring 091 when assembled as shown in Figure 11. The plate-bearing arc 663 is preferably made of a material different from seal ring 658 to facilitate its function as a bearing. Suitable materials include bronze, ceramic, or other metal different from the metal used as the material for seal ring 658.

Page 23, first full paragraph:

Positioned between retaining seal ring 664 and arc 663 is seal ring 658. As shown in Figures 11G and 11H, the seal ring 658 has a radial slot 403 formed throughout its circumference. At one edge of the seal ring 658, the radial slot 403 terminates in a circumferential semi-circular configuration, so that a distribution groove 145 is created when the seal ring 658 abuts against the ring seal housing 659, as shown in Figure 11. Alternatively, more than one radial [slots] slot 403 could be used. In the embodiment shown, ring seal 658 also has a bore 404 formed in communication with and orthogonally to radial slot 403. By pressurizing this bore 404, a counterbalance is created whereby the seal ring 658 is inhibited from moving downwardly due to its own weight. If the orientation of the valve were different, such as rotated 180°, the bore 404 could be formed in the upper portion of seal ring 658.

Alternatively, more than one bore 404 could [e] be used in the upper or lower portions, or both. If the orientation were rotated 90°, for example, no counterbalance would be necessary. Since the seal ring 658 remains stationary and the housing is stationary, seal 658 need not be round; other shapes including oval and octagonal also are suitable. The ring seal 658 can be made of a single piece, or could be two or more pieces.

Paragraph bridging pages 23-24:

The ring seal 658 biases against ring seal housing 659, and remains stationary even as the flow distributor 50 (and seal ring 664, plate bearing arc 663 and mounting ring 091) rotates. Pressurized air (or gas) flows through the radial ducts 83 as shown by the arrows in Figure 11, and into the radial slot 403 and bore 404, as well as in the distribution groove 145 between the ring seal 658 and housing 659, the gap between the retaining ring seal 664 and housing 659, and the gaps between the arc 663 and housing 659 and mounting ring 091 and housing 659. As the flow distributor rotates with respect to stationary housing 659 (and the stationary seal ring 658), the air in these gaps pressurizes these spaces creating a continuous and non-friction seal. The distribution groove 145 divides the outside surface of the ring seal 658 into three zones, with two in contact with the outer bore, and a center pressure zone.

In the claims:

8. (Amended) A regenerative thermal oxidizer for processing a gas, comprising:

a combustion zone;

a first heat exchange bed containing heat exchange media and in communication with said combustion zone;

a second heat exchange bed containing heat exchange media and in communication with said combustion zone;

a rotatable switch valve for alternating the flow of said gas between said first and second heat exchange beds, said rotatable switch valve comprising a radial duct[,] enclosed by an outer housing, and a ring seal in fluid communication with said radial duct, said ring seal having a bore adapted to allow gas flow to or from said radial duct and form a pressurized seal with said outer housing.

9. (Amended) The regenerative thermal oxidizer of claim 8, wherein said rotatable switch valve further comprises a first valve port in fluid communication with said first heat exchange bed and a second valve port separate from said first valve port and in fluid communication with said second heat exchange bed, said regenerative thermal oxidizer further comprising a cold face plenum comprising at least one baffle for dividing said first and second valve ports into a plurality of chambers.

10. (Amended) The regenerative thermal oxidizer of claim 9, wherein each of said chambers is congruent with respect to one another.

12. (Amended) The regenerative thermal oxidizer of claim 8,

further comprising means for causing gas to flow into said radial duct, and between said ring seal and said outer housing [ring seal].